

Grundfos CIU 250

GSM for Grundfos MP 204

GB Functional profile and user manual



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1. Symbols used in this document

Caution

If these safety instructions are not observed, it may result in malfunction or damage to the equipment!

Note

Notes or instructions that make the job easier and ensure safe operation.

2. Introduction

2.1 About this functional profile

This functional profile describes the CIU 250 (GSM/GPRS Communication Interface Unit 250) for the Grundfos MP 204 motor protector.

In the following, the CIU 250 is referred to as "communication interface".

The data in this document are subject to change without prior notice. Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming Modbus devices. The reader should also have some basic knowledge of the Modbus protocol and technical specifications.

It is also assumed that an existing GSM/GPRS network with a Modbus master is present.

2.3 Definitions and abbreviations

0b	Prefix "0b" indicates a binary number.
0x	Prefix "0x" indicates a hexadecimal number.
APN	Access Point Name. Name used to identify a GPRS service in the GSM mobile network.
CIM 250	Grundfos GSM Communication Interface Module (built into the CIU 250).
CIU 250	Grundfos GSM/GPRS Communication Interface Unit.
CRC	Cyclic Redundancy Check. A data error detection method.
CSD	Circuit Switched Data. Connection is established via a fixed connection (a physical circuit or a reserved data channel).
GENIbus	Proprietary Grundfos fieldbus standard.
GPRS	General Packet Radio Service. TCP/IP networking via GSM network.
GRE	Generic Routing Encapsulation. A tunnelling protocol that can encapsulate a TCP packet type inside IP address tunnels, creating a virtual point-to-point link between routers at remote points over the internet.
GSM	Global System for Mobile communications.
LAN	Local Area Network.
LED	Light-Emitting Diode.
Modbus RTU	Modbus is a fieldbus used worldwide. The RTU version is used for wired networks and for call-up connections over telephone networks.
Modbus TCP	Modbus is a fieldbus used worldwide. The TCP version is adapted for use as an application protocol on TCP/IP.
MP 204	Grundfos Motor Protector.
PIN	Personal Identification Number (SIM cards).
PUK	Personal Unblocking Key (SIM cards).

SELV	Separated or Safety Extra-Low Voltage.
SELV-E	Separated or Safety Extra-Low Voltage with Earth connection.
SIM	SIM card, Subscriber Identity Module.
SMA	SubMiniature version A. Coaxial radio signal connection standard.
TCP/IP	Transmission Control Protocol/Internet Protocol. Protocol suitable for internet communication.
Transmission speed	Bits transferred per second.
UTF-8	Unicode Transformation Format (character encoding).
VPN	Virtual Private Network. A network using the internet to connect nodes. These systems use encryption and other security mechanisms to ensure that only authorised users can access the network and that the data cannot be intercepted.

2.4 System diagram

The Grundfos MP 204 is an electronic motor protector. The MP 204 is connected to a Grundfos pump.

The system diagram gives an overview of how to connect the CIU 250 to the Grundfos MP 204 via GENIbus.

The CIU 250 solution is a box with a power supply module and a CIM 250 module. The CIU 250 can either be mounted on a DIN rail or on a wall. See fig. 1.

Remote communication via the CIU 250 can be established by using one of the following options:

- Modbus RTU protocol via a GSM connection
- Modbus TCP protocol via a GPRS connection
- SMS commands from a mobile phone.

Infrared remote communication can also be established with the hand-held Grundfos R100 remote control. This is out of the scope of this manual.

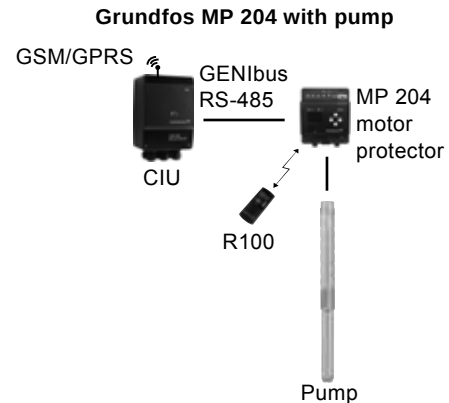


Fig. 1 CIU 250 solution for the MP 204 connected to a pump

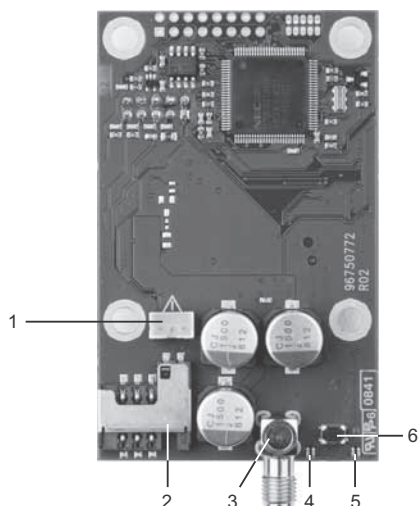
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2.5 Specifications

The table below gives an overview of the specifications for the Grundfos CIU 250. For further details, please refer to the specific sections of this functional profile.

General data	Description	Comments
Ambient humidity	30 % to 95 %	Relative, non-condensing.
Battery, lithium-ion	The battery will only be charged if the battery temperature is within 0 °C to +45 °C.	
GENIbus visual diagnostics	LED2	Will be in one of these states: Off, constantly green, flashing red, constantly red. See section 3.2 LEDs .
Modbus GSM/GPRS specifications		
Data protocol	Modbus RTU/Modbus TCP	
Modbus connection type	GSM/GPRS	
Slave address	Factory 231 (0xE7)	Can be changed via Modbus register 00003, SetModbusAddress.
GSM/GPRS visual diagnostics	LED1	Will be in one of these states: Off, flashing green, flashing red, constantly red. See section 3.2 LEDs .
Maximum Modbus telegram size	256 bytes	Node address and CRC included.

3. CIM 250 GSM module



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Fig. 2 CIM 250 GSM module (top side view)

Pos.	Designation	Description
1		Battery socket
2		SIM card holder
3		SMA connection for GSM antenna
4	LED1	Yellow/green status LED for GSM/GPRS communication
5	LED2	Red/green status LED for internal communication between the CIU 250 and MP 204
6	SW1	Reset button. Keep the button pressed for 5 seconds to return to default settings.

3.1 Installation

Note

Before installation, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

3.1.1 Fitting a GSM antenna

An antenna must be connected to the CIM 250 to establish connection to the GSM network.

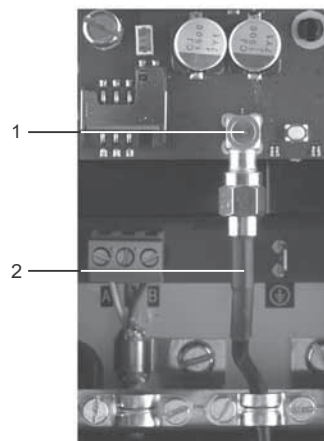
If the CIU 250 is installed in a metal control cabinet, Grundfos recommends to fit an external GSM antenna.

Note

Grundfos offers different kinds of antennas. No antenna is supplied with the CIU 250. It has to be ordered separately.

External antenna

Connect the antenna cable to the SMA connection (pos. 1) of the CIM 250. The antenna must be installed outside the control cabinet in a position with good reception conditions.



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Fig. 3 Fitting an external GSM antenna

Pos.	Description
1	SMA connection for GSM antenna
2	Antenna cable for external GSM antenna

3.1.2 Inserting the SIM card

Before inserting the SIM card into the CIM 250, remove the PIN code, or set the PIN code to "4321".

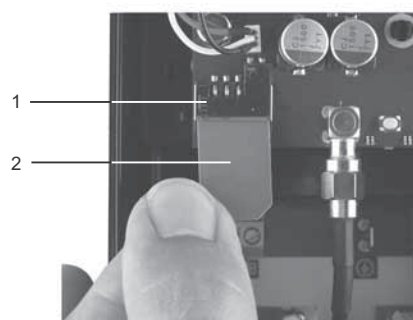
Procedure

1. Insert the SIM card into a mobile phone.
2. Remove the PIN code from the SIM card, or set the PIN code to "4321". See the manual of the mobile phone.
3. Insert the SIM card into the CIM 250. See fig. 4.

The slanted edge of the SIM card must point downwards.

Note

The connectors on the SIM card must point downwards towards the CIM 250. See fig. 4.



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Fig. 4 Inserting the SIM card

Pos.	Description
1	SIM card holder
2	SIM card

3.1.3 Connecting the battery and power supply



Warning

The CIM 250 must only be connected to SELV or SELV-E circuits.



Warning

The safety precautions listed below must be observed carefully as improper handling of the lithium-ion battery may result in injury or damage from electrolyte leakage, heating ignition or explosion.

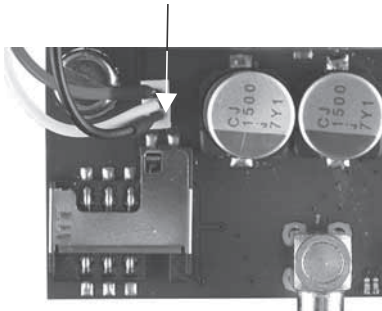
These safety precautions must be observed:

- Only insert the approved Grundfos battery pack (96881516).
- Never use this battery pack in other battery chargers.
- Do not dismantle or modify the battery.
- Do not heat or incinerate the battery.
- Do not pierce, crush or cause mechanical damage to the battery.
- Do not short-circuit the battery.
- Do not allow the battery to get wet or be immersed in water.
- Do not strike or throw the battery.
- For long periods of storage, the temperature should be below 45 °C.

The CIM 250 is fitted with a lithium-ion battery. It is secured by a velcro strap which absorbs vibrations and makes it easier to replace the battery. Connect the battery to the CIM 250 as shown in fig. 5.

Note

If the battery is not connected, the user will not receive any SMS alarm message in case of a power cut.



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Fig. 5 Connecting the battery

Note

The battery will only be charged if the battery temperature is within 0 °C to +45 °C.

Switch on the power supply. The CIM 250 is powered either by the CIU 250 or by the battery.

The LED1 is flashing yellow (searching for GSM network).

When the connection to the GSM network has been established, the LED1 will pulsate yellow (GSM network active). See fig. 6.

The LED2 must be constantly green, indicating that the CIM 250 has been fitted correctly in the CIU 250.

3.1.4 Configuration

For software configuration of the CIU 250, which includes setting of SMS functions and SCADA communication parameters, see "CIM 25X SMS commands" (supplement to installation and operating instructions) on the CD-ROM supplied with the GSM module.

3.2 LEDs

The CIM 250 GSM module has two LEDs.

See fig. 2.

- Yellow/green status LED (LED1) for GSM/GPRS communication
- Red/green status LED (LED2) for internal communication between the CIU 250 and the MP 204.

LED1 (yellow/green)

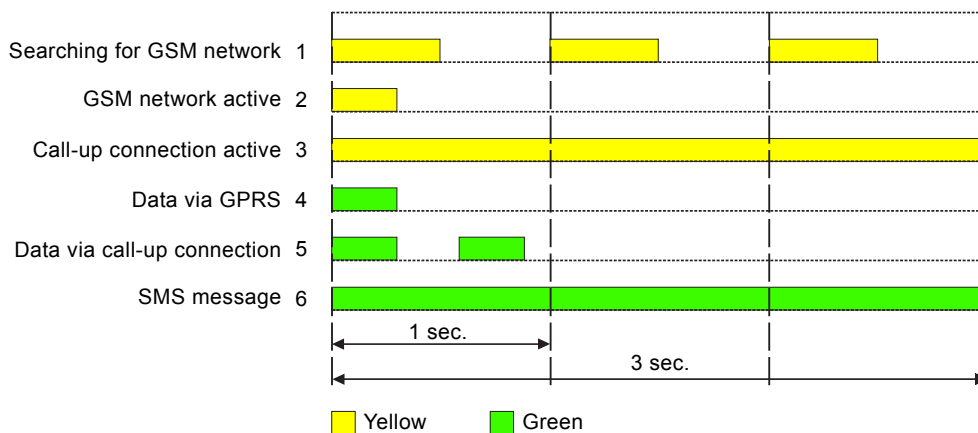


Fig. 6 LED1 status

Pos.	Status	Description
1	Flashing yellow.	Searching for GSM network.
2	Pulsating yellow (single pulse).	Connection to the GSM network has been established.
3	Constantly yellow.	Call-up connection has been established.
4	Pulsating green (single pulse).	Data are exchanged via GPRS.
5	Pulsating green (double pulse).	Data are exchanged via the call-up connection.
6	Green (3 sec.).	Sending or receiving an SMS message.

LED2 (red/green)

Status	Description
Off.	The CIU 250 has been switched off.
Flashing red.	No communication between the CIU 250 and the MP 204.
Constantly red.	The CIU 250 does not support the connected version of the MP 204.
Constantly green.	The connection between the CIU 250 and the MP 204 is OK.

Note

The CIU 250 must have finished its start-up sequence before the LED2 can be used for status. This means that a certain delay may occur before the LED2 turns green after start-up of the CIU 250.

4. Modbus function code overview

The supported function codes are shown in the table below:

Type	Code	Hex	Name
16-bit data (registers)	03	0x03	Read holding registers
	04	0x04	Read input registers
	06	0x06	Write single register
	16	0x10	Write multiple registers
Diagnostics	08	08	Diagnostics See section 11.6 Diagnostics (0x08) for subcodes.

Note

Reading or writing coils are not supported.

The same data are available in both holding registers and input registers, meaning that either function (0x03 or 0x04) can be used for reading data.

Examples illustrating the use of the supported function codes can be found in section 11. [Modbus telegrams and function codes](#).

Modbus telegram examples illustrating the use of the functional profile can be found in section 12. [Modbus telegram examples](#).

5. Functional profile

5.1 Register block overview

The Modbus RTU registers are grouped in the following register blocks:

Start address	Register block	Permissions	Description
00001	CIM configuration	R/W	Configuration of the CIM module.
00021	CIM status	R	Status registers for the CIM module.
00101	MP 204 control	R/W	Registers for control of the MP 204.
00201	MP 204 status	R	Registers for status from the MP 204.
00301	MP 204 data	R	Registers for measured data values from the MP 204.
00701	Alarm simulation	R/W	Registers for alarm and warning simulation.
00751-00800	User	R/W	The CIU 250 will not modify this area by itself.

All addresses contain registers. Some are bit-interpreted while others are 16-bit values, or part of 32-bit values. A data value of 65535 (0xFFFF) indicates "not available" when reading registers. The value of 65535 (0xFFFF) does not imply a "disable" when writing values.

Each register block will be specified in more detail in the following sections.

5.2 CIM configuration register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

Address	Register name	Description
00001	SlaveMinimumReplyDelay	Not used.
00002	RegisterOffset	An address offset that is added to all addresses above 00100. Default value is 0. Note: This offset does not affect the CIM configuration register block or the CIM status register block addresses. The register offset value is stored in the device and will remain after a power-off. For most applications, this offset should not be changed.
00003	SetModbusAddress	The value is stored in the device and will remain after a power-off. Legal values are 1 - 247. Default value of this register is 0xE7 (231), which should normally not be changed.
00004	SoftwareDefinedBitRate	Not used.
00005	AutoAckControlBits	Used to select the behaviour of control bit acknowledgements from the CIU 250. 0 = Disabled. Control bits are not automatically lowered when accepted by the device. The user must lower the triggered control bit manually before the control bit can be triggered again. 1 = Enabled. Control bits are automatically lowered when accepted by the device. The user does not have to lower it manually [default]. General acknowledgement bit information register 00208 (when automatic acknowledgement is disabled): Acknowledgement bits will be set when the CIU 250 has accepted the corresponding control bits, and the user can clear the control bits. The acknowledgement bit will automatically be cleared to 0 by the CIU 250 when the control bit is cleared by the master device, and a new command can be attempted by raising the control bit again.
00006	ReadWriteSeparation	Not used.
00007-00008	RESERVED	-
00009	SoftwareDefinedParity	Not used.
00010	SoftwareDefinedStopBit	Not used.
00011	ScadaPinCode	PIN code for SCADA systems, etc. If GeneralStatus.ScadaPinCodeEnabled (register 00029, bit 0) is enabled, the correct PIN code must be entered in this register in order to gain access to remote control and configuration. Verify acceptance in GeneralStatus.WriteAccess (register 00029, bit 1). Programming of the SCADA PIN code made via the SMS command SETSCADACODE. See "CIM 25X SMS commands" (supplement to installation and operating instructions) on the CD-ROM supplied with the GSM module.

5.3 CIM status register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They are read-only. This block can be used for various kinds of fault finding.

Address	Register name	Description
00021	GENIbusCRCErrorCnt	Holds a CRC error counter for the connection between the CIU 250 and the MP 204.
00022	GENIbusDataErrorCnt	Holds a data error counter for the connection between the CIU 250 and the MP 204.
00023	VersionNumber	A Grundfos-specific version number. This is an unsigned integer value.
00024	ActualModbusAddress	Holds the current Modbus slave address of the device. Valid value range: 1...247.
00025	GENIbusTXcountHI	Holds a transmit counter for total number of telegrams sent from the CIU 250 to the MP 204.
00026	GENIbusTXcountLO	
00027	GENIbusRXcountHI	Holds a receive counter for total number of telegrams received by the CIU 250 from the MP 204.
00028	GENIbusRXcountLO	
00029	GeneralStatus Bit 0: ScadaPinCodeEnabled	PIN code functionality. 0 = No PIN code required 1 = PIN code required to perform remote control and configuration. Activation of SCADA PIN code protection takes place via the SMS command SCADACODE. See "CIM 25X SMS commands" (supplement to installation and operating instructions) on the CD-ROM supplied with the GSM module.
	GeneralStatus Bit 1: WriteAccess	Remote write access. 0 = No write access (the PIN code is incorrect). 1 = Full write access (the PIN code is either correct or not enabled).
00030	UnitFamily	Grundfos product family.
00031	UnitType	Grundfos product type.
00032	UnitVersion	Grundfos product version.

5.4 MP 204 control register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They can be written as holding registers with function codes 0x06 and 0x10. The MP 204 will react to its last received command, no matter whether this command was triggered via Modbus, with the R100 remote control or on the MP 204 operator buttons.

Address	Register name	Description
00101	ControlRegister Bit 0: ResetAlarm	Control bit that resets alarms and warnings. 0 = No resetting 1 = Resetting alarm. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.
	ControlRegister Bit 1: CommandedTrip	Control bit that command-trips the MP 204. Status is obtained from OperationMode (register 00202). 0 = No trip 1 = Trip. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.
	ControlRegister Bit 2: OnOffReq	Control bit that switches the pump on and off. Status is obtained from OperationMode (register 00202). 0 = Off (stop) 1 = On (start).
	ControlRegister Bit 3: ProtectionEnabled	Control bit that enables/disables the general protection. Status is obtained from StatusRegister (register 00201, bit 1). 0 = Protection disabled 1 = Protection enabled.
	ControlRegister Bit 5: ResetStartCounter	Control bit that resets the NumberOfStartsTripCounterHI/LO (registers 00342 and 00343). 0 = No resetting 1 = Resetting. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.
	ControlRegister Bit 6: ResetRestartCounter	Control bit that resets the AutoRestartsTripCounterHI/LO (registers 00344 and 00345). 0 = No resetting 1 = Resetting. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.
	ControlRegister Bit 7: ResetLogs	Control bit that resets the maximum/minimum voltage and current logs and maximum number of starts per hour log (registers 00348, 00349, 00350, 00351 and 00352). 0 = No resetting 1 = Resetting. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.
	ControlRegister Bit 8: ResetHourCounter	Control bit that resets the OperationTimeTripCounterHI/LO (registers 00338 and 00339). 0 = No resetting 1 = Resetting. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.
	ControlRegister Bit 9: ResetEnergyCounter	Control bit that resets the EnergyTripCounterHI/LO (registers 00332 and 00333). 0 = No resetting 1 = Resetting. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block , address 00005, for acknowledgement behaviour.

5.5 MP 204 status register block

Registers in this register block can be read by means of function codes 0x03 and/or 0x04. They are read-only.

Address	Register name	Description
00201	StatusRegister Bit 0: Rotation	Indicates if the pump is rotating (consuming power) or not. 0 = No rotation 1 = Rotation.
	StatusRegister Bit 1: ProtectionEnabled	Indicates if the general protection is enabled or disabled. 0 = Protection disabled 1 = Protection enabled. Protection can be enabled/disabled with ControlRegister (register 00101, bit 3).
	StatusRegister Bit 2: Ready	Indicates if the MP 204 is ready or not. 0 = Not ready 1 = Ready.
	StatusRegister Bit 3: Fault	Indicates if there is a fault or not. 0 = No fault 1 = Fault.
	StatusRegister Bit 4: PTC	Indicates status of the PTC. 0 = Closed 1 = Open.
	StatusRegister Bit 5: PhaseSequence	Indicates the actual phase sequence. 0 = Phase sequence is right: L1-L2-L3 1 = Phase sequence is left: L3-L2-L1.
00202	OperationMode	Indicates the actual operating mode. 0 = Started (on, normal condition) 1 = Commanded trip (result of control register 00101, bit 1) 2 = Actuator stop (off) (result of control register 00101, bit 2) 3 = Protection stop.
00203	SystemMode	Indicates the actual system mode. 0 = Power-up 1 = Operating (normal condition) 2 = MP 204 fault.
00204	AlarmCode	The Grundfos-specific alarm code. See section 10. Grundfos alarm and warning codes .
00205	WarningBits1	Bit-interpreted warnings Bit 0 = Maximum voltage Bit 1 = Minimum voltage Bit 2 = Maximum line current Bit 3 = Minimum line current Bit 4 = Line current asymmetry Bit 5 = RESERVED Bit 6 = RESERVED Bit 7 = RESERVED Bit 8 = Insulation resistance Bit 9 = Motor temperature (Tempcon) Bit 10 = Motor temperature (PT resistor) Bit 11 = RESERVED Bit 12 = Maximum cos ϕ warning limit exceeded Bit 13 = Minimum cos ϕ warning limit exceeded Bit 14 = Starts per hour Bit 15 = RESERVED.
00206	WarningBits2	Bit-interpreted warnings Bit 0 = Start capacitor min. Bit 1 = Run capacitor min. Bit 2 = RESERVED Bit 3 = Tempcon sensor signal fault Bit 4 = Pt sensor signal fault Bit 5 = Service warning: Operating time trip counter has exceeded its warning limit. Bit 6 = Load continues even if the motor has been switched off Bits 7-15 = RESERVED.
00207	Relays Bit 0: ControlRelay	Indicates the status of the motor control relay. 0 = Relay opened 1 = Relay closed (power-on default after timeout).
	Relays Bit 1: SignalRelay	Indicates the status of the alarm signal relay. 0 = Relay opened (power-on default) 1 = Relay closed.

Address	Register name	Description
00208	AcknowledgeRegister Bit 0: ResetAlarmAck	Indicates if a ResetAlarm control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
	AcknowledgeRegister Bit 1: TripAck	Indicates if a commanded-trip control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
	AcknowledgeRegister Bits 2-4: RESERVED	-
	AcknowledgeRegister Bit 5: ResetStartCounterAck	Indicates if a ResetStartCounter control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
	AcknowledgeRegister Bit 6: ResetRestartCounterAck	Indicates if a ResetRestartCounter control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
	AcknowledgeRegister Bit 7: ResetLogsAck	Indicates if a ResetLogs control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
	AcknowledgeRegister Bit 8: ResetHourCounterAck	Indicates if a ResetHourCounter control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
	AcknowledgeRegister Bit 9: ResetEnergyCounterAck	Indicates if a ResetEnergyCounter control bit was acknowledged by the device. 0 = No acknowledgement 1 = Control bit acknowledged. This functionality is only used when AutoAckControlBits is disabled. See section 5.2 CIM configuration register block , address 00005.
00236	GSMSignalLevelActual	Actual level of GSM signal.
00237	GSMSignalLevelAverage	Average level of GSM signal.
00238	IPAddressHI	IP address for GPRS communication.
00239	IPAddressLO	

5.6 MP 204 data register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They are read-only. The table below shows the availability of the data, depending on system configuration.

Address	Register name	Scale	Notes
00301	PhaseVoltageL1	0.1 V	
00302	PhaseVoltageL2	0.1 V	
00303	PhaseVoltageL3	0.1 V	
00304	PhaseVoltageMean	0.1 V	
00305	LineVoltageL1L2	0.1 V	
00306	LineVoltageL2L3	0.1 V	
00307	LineVoltageL3L1	0.1 V	
00308	LineVoltageMean	0.1 V	
00309	LineCurrentL1	0.1 A	
00310	LineCurrentL2	0.1 A	
00311	LineCurrentL3	0.1 A	
00312	LineCurrentMean	0.1 A	
00313	LineCurrentStart	0.1 A	
00314	MotorTemp1	0.01 K	
00315	MotorTemp2	0.01 K	
00316	LineCurrentAsym	0.1 %	
00317	CapacitorStart	1 µF	
00318	CapacitorRun	1 µF	
00319	CapacitorStartRef	1 µF	
00320	CapacitorRunRef	1 µF	
00321	LineFrequency	0.1 Hz	
00322	VoltageAngleL1L2	1 degree	
00323	VoltageAngleL1L3	1 degree	
00324	CosPhiL1	0.01	
00325	CosPhiL2	0.01	
00326	CosPhiL3	0.01	
00327	CosPhi	0.01	
00328	PowerHI	1 W	
00329	PowerLO		
00330	EnergyHI	1 kWh	
00331	EnergyLO		
00332	EnergyTripCounterHI	1 kWh	Reset with ControlRegister (register 00101, bit 9).
00333	EnergyTripCounterLO		
00334	OperationTimeHI	1 hour	
00335	OperationTimeLO		
00336	TotalPoweredTimeHI	1 hour	
00337	TotalPoweredTimeLO		
00338	OperationTimeTripCounterHI	1 hour	Reset with ControlRegister (register 00101, bit 8).
00339	OperationTimeTripCounterLO		
00340	NumberOfStartsHI	unscaled	
00341	NumberOfStartsLO		
00342	NumberOfStartsTripCounterHI	unscaled	Reset with ControlRegister (register 00101, bit 5).
00343	NumberOfStartsTripCounterLO		
00344	AutoRestartsTripCounterHI	unscaled	Reset with ControlRegister (register 00101, bit 6).
00345	AutoRestartsTripCounterLO		
00346	InsulationResistance	10 kΩ	
00347	PhaseVoltageDistortion	0.01 %	
00348	VoltageMaxLog	0.1 V	Reset with ControlRegister (register 00101, bit 7).
00349	VoltageMinLog	0.1 V	
00350	CurrentLineMaxLog	0.1 A	
00351	CurrentLineMinLog	0.1 A	
00352	StartsHourMaxLog	unscaled	
00353	StartsPerHour	unscaled	
00354	AutoRestartsPer24h	unscaled	

See section 9. [Data item overview](#) for more information on this register block.

5.7 Alarm simulation register block

Registers in this register block can be read by means of function codes 0x03 and/or 0x04.

Address	Register name	Description
00701	SimulationWarningBits1	Used to generate simulated alarms/warnings.
00702	SimulationWarningBits2	Simulated alarms and warnings can be cleared with the ResetAlarm control bit (register 00101, bit 0) or by pressing the "R" button on the MP 204. Bit interpretation like WarningBits1 (register 00205) and WarningBits2 (register 00206).
00703	SimulationAlarmBits1	
00704	SimulationAlarmBits2	

5.8 User register block

Address	Register name	Scale	Description
00751-00800	UserRegisters	unscaled	This area is for device labelling by the user (SCADA system). The CIU 250 will not modify this area by itself. The user register values are stored in the device and will remain after a power-off.

6. GSM call-up connection to SCADA system

6.1 Call-up functional description

The call-up function is used for SCADA system communication via the GSM network. Connection is established when the SCADA system dials the CIU 250. The CIU 250 will automatically "pick up the phone call" and wait for data traffic in the form of Modbus RTU telegrams.

If legal data traffic has not been initiated within one minute, the CIU 250 will hang up the line. This silence timeout is active during the whole communication session. Whenever the SCADA system has completed the Modbus communication, it hangs up the line. This is detected by the CIU 250, which also hangs up the line, and the call-up communication session is thereby completed. See fig. 7.

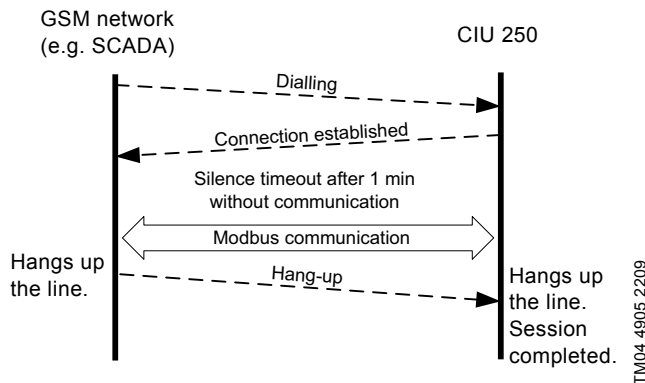


Fig. 7 Illustration of a GSM call-up session

6.2 SCADA PIN code protection

It is always possible to get read access via Modbus, but if the CIU 250 is SCADA PIN-code-protected (GeneralStatus register 00029, bit 0 = 1), write access requires that the correct PIN code (ScadaPinCode, register 00011) has been written. Writing the correct PIN code value will trigger the write access control, and write access will be open, which can be verified with GeneralStatus, register 00029, bit 1 = 1).

For call-up connections with PIN code protection, the ScadaPinCode register has to be written each time a new call-up is made.

6.3 GSM call-up options setup

To prepare the CIU 250 for Modbus communication with a SCADA system via GSM, some settings have to be made via SMS commands:

- Setting a SCADA PIN code:
SETSCADACODE <access code>
will enable write access protection.

Default is an empty SCADA PIN code, meaning no protection.

- Activating the SCADA PIN code:
SCADACODE <ON | OFF>.

Default is "Off".

- Selecting the Modbus address:
MODBUSADDR <1-247>

Default value is 231.

To verify the SCADA GSM setting after completion, the SMS command "SCADA" can be used.

For details about the use of SMS commands, see "CIM 25X SMS commands" (supplement to installation and operating instructions) on the CD-ROM supplied with the GSM module.

7. GPRS connection

7.1 What is GPRS and Modbus TCP?

GPRS (General Packet Radio Service) is a wireless, "always on" connection that remains active as long as the CIU 250 is within range of the service. With GPRS it is possible to establish a wireless connection to the internet and thus enable a remote connection to a SCADA system computer or another PC application. Typical data rates are 32 to 48 kbit/s.

The GPRS itself takes care of the wireless data transfer via the GSM network. It plays the same role as Ethernet in a wired network. On top of GPRS is the TCP/IP protocol, which enables easy integration with the internet. The Modbus TCP protocol is used on the application layer communicating with a TCP port number (default 502). The difference when compared to the fieldbus protocol Modbus RTU is the exclusion of the 16-bit CRC checksum and the adding of a Modbus application program header as illustrated in fig. 8.

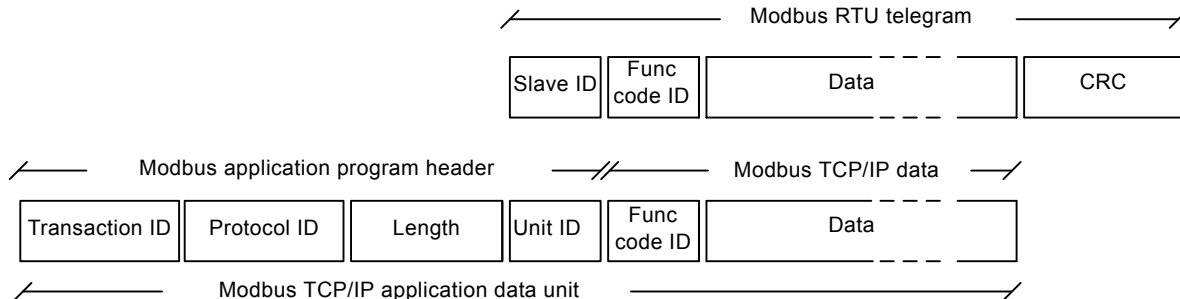


Fig. 8 Modbus TCP telegram

7.2 Subscription

The GSM service providers have different technical solutions for GPRS to choose from. You have to select the service provider and the technical solution that best suit your system, and it must be based on static IP addressing. You will get the following from the GSM service provider:

- A Subscriber Identity Module (SIM card).
- An Access Point Name (APN), e.g. "internet".
- A username (is fixed and cannot be changed by the user).
- A password (is fixed and cannot be changed by the user).
- A static IP address.

Solutions based on a VPN (Virtual Private Network) involve the use of special routers, e.g. GRE routers, Generic Routing Encapsulation, which you will also get from the service provider.

7.3 Installation

To prepare the CIU 250 for GPRS communication, some settings have to be made via SMS commands:

- Select Access Point Name:
APN <ascii string>
This is always mandatory.
- Select Username:
USERNAME <ascii string>
The need for a username depends on your operator and the type of subscription.
- Select Password:
PASSWORD <ascii string>
The need for a password depends on your operator and the type of subscription.

Some advanced GPRS settings have default values that usually work, but in special cases, it might be necessary to change some of them. This is also done via SMS commands.

- Select Authentication:
AUTHENTICATION <NORMAL | SECURE>
Only used by some service providers. Default value is "Normal".
- Select Connection type:
CONNECTION <SERVER | CLIENT | DISABLE>
Default value is "Server".
- Set GPRS roaming:
GPRSROAMING: <ON | OFF>
Default value is "Off".
- Select Modbus TCP port number:
MODBUSPORT <port no.>
Default value is 502.
- Select GENIpro port number:
GENIPROPORT <port no.>
Default value is 49152. This is only relevant when using Grundfos PC Tools.

It is possible to configure the GPRS connection with a single multi-parameter command:

- SETGPRS <parameter 1, parameter 2, parameter 3, ...>
– <parameters>: <APN>, <Modbus port>, <GENIpro port>, <user name>, <password>, <authentication>, <connection>, <GPRS roaming>

Example

SETGPRS Grundfos.dk2.tdc,502,49888,Grundfos,4321,normal,server,off

To verify the GPRS setting after completion, the SMS command GPRSSETTING can be used. The command GPRSSTATUS can verify if the GPRS connection is working.

The connection states have the following meaning:

- "Detached": Trying to locate GPRS service.
- "Attached": GPRS service located.
- "Context active": IP address has been assigned, ready for a client to establish a socket connection.
- "Connected": A client has established a socket connection. The system is ready for TCP/IP data exchange (or already exchanging data).

For details about the use of SMS commands, see "CIM 25X SMS commands" (supplement to installation and operating instructions) on the CD-ROM supplied with the GSM module.

7.4 Operation

When powering on a CIU 250 with the correct GPRS setting, the following GPRS connection sequence will take place:

1. The CIU 250 locates the GPRS service. The connection state changes from "Detached" to "Attached".
2. The CIU 250 attempts to connect to the APN it has been given and requests an IP address. The base station looks through its record of legal SIM cards and finds the IP address (the address associated with this SIM card) to assign to the CIU 250. After the CIU 250 has got the IP address, the connection state changes to "Context active".
3. The CIU 250 is now ready for a client (e.g. SCADA system) to establish a socket connection and begin TCP/IP data exchange. When a client connects the CIU 250, the connection state will change to "Connected", and the GSM status LED1 will indicate when data transfer takes place. See section 3.2 LEDs.

Note

When no GPRS data is being transferred, the connection states "Attached", "Context active" and "Connected". All show the same LED1 status (short pulse).

A client (e.g. SCADA) establishes connection to a CIU 250 by specifying the IP address and the TCP port 502. Data transfer is always initiated from the client in the form of a Modbus TCP telegram embedded in a TCP/IP frame and directed to TCP port 502. To the client software, the connection to the CIU 250 is completely transparent.

The protection against unauthorised data access is high. The access to the GPRS network from the internet can only take place via the VPN tunnel. See fig. 10. Moreover, data transfer requires a Modbus master client, knowledge of the Modbus functional profile and the use of a SCADA PIN code (if enabled).

The CIU 250 supervises the GPRS system to ensure that it is still working. An automatic procedure ensures restarting of the CIU 250 and repetition of the GPRS connection sequence in case a deadlock situation has occurred. It also closes down socket connections that are left open by the client and unused for more than 24 hours.

It is possible to use SMS communication while GPRS communication is active. However, in the "Connected" state the delay time between reception and reply will increase.

If the connection state is different from "Connected", it is possible to establish a call-up connection. When the call-up connection is established, GPRS data exchange will be blocked until the call-up is terminated by the caller.

A total of three Modbus clients can be connected to the Modbus TCP port of the CIU 250 and communicate simultaneously. Each connection, called a socket connection, is handled independently. If all three sockets are used simultaneously, a "Silence timeout" of only one minute is used to prevent a complete occupation for a long time.

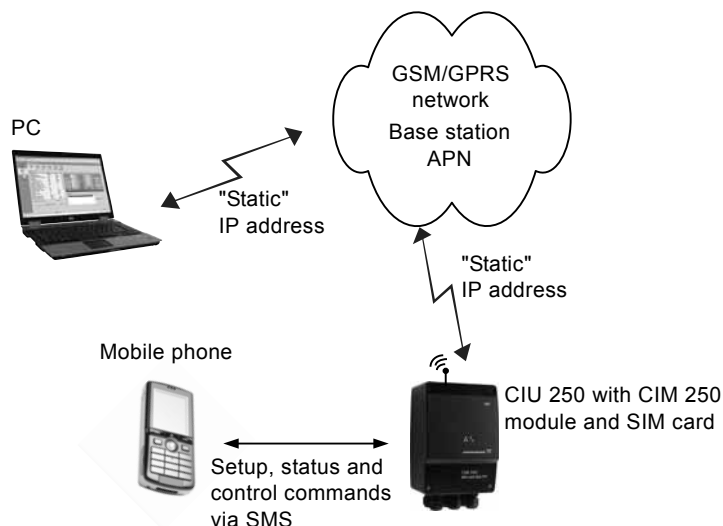


Fig. 9 GPRS connection from a PC to the CIU 250 directly via GPRS

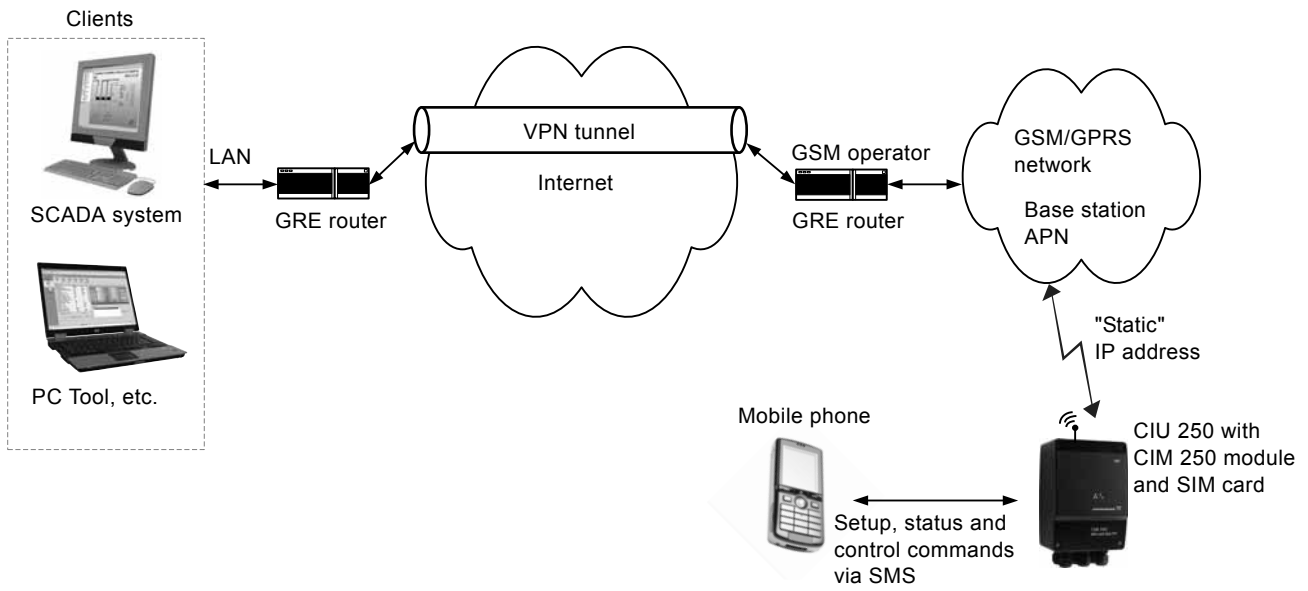


Fig. 10 GPRS connection via VPN tunnel

TM04 7129 1510

8. Fault finding

Faults in the CIU 250 can be detected by observing the status of the two communication LEDs. See the table below and section [3.2 LEDs](#).

8.1 LED status

CIU 250 connected to an MP 204

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIU 250 is defective.	Replace the CIU 250.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIU 250 and the MP 204.	• Check the cable connection between the MP 204 and the CIU 250. • Check that the individual conductors have been fitted correctly. • Check the power supply to the MP 204.
3. The LED for internal communication (LED2) is constantly red.	a) The CIU 250 does not support the connected version of the MP 204.	Contact the nearest Grundfos company.
4. The LED for GSM/GPRS communication (LED1) is flashing yellow. See signal 1 in fig. 6 on page 7.	a) The SIM card has not been inserted.	Insert the SIM card. See section 3.1.2 Inserting the SIM card .
	b) The SIM card has not been inserted correctly.	Insert the SIM card. See section 3.1.2 Inserting the SIM card .
	c) The SIM card PIN code is not correct.	Enter the correct PIN code. See section 3.1.2 Inserting the SIM card .
	d) No connection to the GSM network.	• Check the connection to the antenna. • Check the GSM coverage of the area with for instance a mobile phone. • Use an external antenna and experiment with the position.
5. The LED for GSM/GPRS communication is pulsating yellow with single pulse, but the CIM 250 cannot send or receive SMS messages.	a) The CIM 250 has not been initialised.	Follow the configuration procedure in "CIM 25X SMS commands" (supplement to installation and operating instructions) on the CD-ROM supplied with the GSM module.

8.2 Modbus GSM/GPRS communication faults

Fault	Possible cause	Remedy
1. The slave does not respond to telegrams.	a) Configuration or installation error.	- Ensure that the CIU 250 has contact with the GSM network. The LED1 should be pulsing yellow. - If the LED1 signal is incorrect, see section 3. CIM 250 GSM module for correct installation of the CIM 250. - Ensure that the correct slave address is used in the Modbus master poll. See register 00003 ModbusAddress (factory value is 00231).
	b) The slave may be in listen-only mode.	Either send a restart communications diagnostics command, or restart the MP 204 manually.
	c) If the holding register of address 00001 "SlaveMinimumReplyDelay" is set too high, the master may time out before receiving the response from the slave.	Increase the reply delay in the master or reduce the "SlaveMinimumReplyDelay" in order to communicate.
2. The slave responds with exception response 0x01: "Invalid function".	a) The master is trying to use an unsupported function in the CIU 250.	See section 4. Modbus function code overview for supported function codes. Note that reading and writing coils are not supported, so only register functions and diagnostics will be valid.
3. The slave responds with exception response 0x02: "Invalid data address".	a) The master is trying to read or write an invalid data address. If a master tries to read register addresses that are not listed in the tables, the slave will respond with this exception response. Some masters may automatically try to read large blocks in one telegram, which will cause problems if some of the registers in the block are not supported. An example would be reading the CIM configuration and CIM status register blocks in one telegram: this is not possible since there are unused addresses among the blocks.	Avoid reading or writing invalid data addresses.
4. The slave returns data value 0xFFFF (65535).	a) The availability of data will in some cases depend on a configuration or the actual conditions of the system (e.g. trying to request data from a pump which is not present will return "data not available" (0xFFFF)).	See section 9. Data item overview for available data.
	b) With its present configuration or operating mode the MP 204 is unable to supply the requested data.	-
5. The slave does not react to control actions or to writing of settings.	a) The CIU 250 is SCADA PIN-code-protected (GeneralStatus register 00029, bit 0 = 1), and an incorrect PIN code has been written.	Write access requires a correct PIN code (ScadaPinCode, register 00011). Writing the correct PIN code value will trigger the write access control, and write access will be open, which can be verified with GeneralStatus, register 00029, bit 1 = 1.

9. Data item overview

bits: The data item is bit-interpreted.

enum: The data item has a pre-defined enumeration.

unscaled: The data item is unscaled (e.g. a number, a counter, etc.).

Register	Identifier	Scale	R/W	Description
CIM configuration register block				
00001	SlaveMinimumReplyDelay	ms	R/W	Minimum Modbus reply delay in ms.
00002	RegisterOffset	unscaled	R/W	Modbus address offset.
00003	ModbusAddress	unscaled	R/W	Is used if the rotary switch value is invalid.
00004	ModbusBitRate	unscaled	R/W	Software-defined transmission speed.
00005	AutoAckControlBits	bool	R/W	Setup of event acknowledgement behaviour.
00011	ScadaPinCode	unscaled		PIN code for SCADA systems, etc. See section 5.3 CIM status register block .
CIM status register block				
00021	GrundfosCRCErrorCnt	unscaled	R	Grundfos GENIbus CRC error counter.
00022	GrundfosDataErrorCnt	unscaled	R	Grundfos GENIbus data error counter.
00023	VersionNumber	unscaled	R	Version number.
00024	ActualModbusAddress	unscaled	R	Actual Modbus slave address.
00025	GrundfosTXcountHI	unscaled	R	Grundfos GENIbus transmit counter.
00026	GrundfosTXcountLO			
00027	GrundfosRXcountHI	unscaled	R	Grundfos GENIbus receive counter.
00028	GrundfosRXcountLO			
00029	GeneralStatus	bools		PIN code functionality. See section 5.3 CIM status register block .
00030	UnitFamily	unscaled		Grundfos product family.
00031	UnitType	unscaled		Grundfos product type.
00032	UnitVersion	unscaled		Grundfos product version.
MP 204 control register block				
00101	ControlRegister	bits	W	Register for control bits. See section 5.4 MP 204 control register block .
MP 204 status register block				
00201	StatusRegister	bits	R	Actual modes. See section 5.5 MP 204 status register block .
00202	OperationMode	enum	R	Actual MP 204 operating mode. See section 5.5 MP 204 status register block .
00203	SystemMode	enum	R	Actual MP 204 system mode. See section 5.5 MP 204 status register block .
00204	AlarmCode	enum	R	Grundfos-specific alarm code. See section 11. Modbus telegrams and function codes .
00205	WarningBits1	bits	R	Warning bits. See section 5.5 MP 204 status register block .
00206	WarningBits2	bits	R	Warning bits. See section 5.5 MP 204 status register block .
00207	Relays	bits	R	See section 5.5 MP 204 status register block .
00208	AcknowledgeRegister	bits	R	A register that contains acknowledgement bits, corresponding to control bits. See section 5.5 MP 204 status register block .
00236	GSMSignalLevelActual	1 %		Actual level of GSM signal.
00237	GSMSignalLevelAverage	1 %		Average level of GSM signal.
00238	IPAddressHI	unscaled		IP address for GPRS communication.
00239	IPAddressLO			
MP 204 data register block				
00301	PhaseVoltageL1	0.1 V	R	Three-phase motor: Phase voltage for L1. Single-phase motor: Equals 0 V (reference).
00302	PhaseVoltageL2	0.1 V	R	Three-phase motor: Phase voltage for L2. Single-phase motor: Phase voltage.
00303	PhaseVoltageL3	0.1 V	R	Three-phase motor: Phase voltage for L3. Single-phase motor: Auxiliary winding voltage.
00304	PhaseVoltageMean	0.1 V	R	Three-phase motor: Mean of the phase voltages. Single-phase motor: Phase voltage for L1.

Register	Identifier	Scale	R/W	Description
00305	LineVoltageL1L2	0.1 V	R	Three-phase motor: Voltage between L1-L2. Single-phase motor: Not available.
00306	LineVoltageL2L3	0.1 V	R	Three-phase motor: Voltage between L2-L3. Single-phase motor: Not available.
00307	LineVoltageL3L1	0.1 V	R	Three-phase motor: Voltage between L3-L1. Single-phase motor: Not available.
00308	LineVoltageMean	0.1 V	R	Three-phase motor: Mean of the line voltages. Single-phase motor: Not available.
00309	LineCurrentL1	0.1 A	R	Three-phase motor: Line current for L1. Single-phase motor: Neutral current.
00310	LineCurrentL2	0.1 A	R	Three-phase motor: Line current for L2. Single-phase motor: Current in mains winding.
00311	LineCurrentL3	0.1 A	R	Three-phase motor: Line current for L3. Single-phase motor: Current in auxiliary winding.
00312	LineCurrentMean	0.1 A	R	Three-phase motor: Mean of the line currents. Single-phase motor: Line current for L1.
00313	LineCurrentStar	0.1 A	R	Line start current measured as the peak of the rms value for a period.
00314	MotorTemp1	0.01 K	R	Motor temperature measured by Tempcon.
00315	MotorTemp2	0.01 K	R	Motor temperature measured by Pt sensor.
00316	LineCurrentAsym	0.1 A	R	Line current asymmetry.
00317	CapacitorStart	1 μ F	R	Start capacitor value.
00318	CapacitorRun	1 μ F	R	Run capacitor value.
00319	CapacitorStartRef	1 μ F	R	Start capacitor reference value (result of learning function or preset).
00320	CapacitorRunRef	1 μ F	R	Run capacitor reference value (result of learning function or preset).
00321	LineFrequency	0.1 Hz	R	Line frequency.
00322	VoltageAngleL1L2	1 degree	R	Voltage angle between L1-L2.
00323	VoltageAngleL1L3	1 degree	R	Voltage angle between L1-L3.
00324	CosPhiL1	0.01	R	Current phase angle cosine for L1.
00325	CosPhiL2	0.01	R	Current phase angle cosine for L2.
00326	CosPhiL3	0.01	R	Current phase angle cosine for L3.
00327	CosPhi	0.01	R	Power factor.
00328	PowerHI	1 W	R	Power consumption.
00329	PowerLO			
00330	EnergyHI	1 W	R	Energy consumption.
00331	EnergyLO			
00332	EnergyTripCounterHI	1 kWh	R	Energy consumption trip counter.
00333	EnergyTripCounterLO			
00334	OperationTimeHI	1 hour	R	Operating time counter.
00335	OperationTimeLO			
00336	TotalPoweredTimeHI	1 hour	R	Power-on time counter.
00337	TotalPoweredTimeLO			
00338	OperationTimeTripCounterHI	1 hour	R	Operating time trip counter.
00339	OperationTimeTripCounterLO			
00340	NumberOfStartsHI	unscaled	R	Number of starts counter.
00341	NumberOfStartsLO			
00342	NumberOfStartsTripCounterHI	unscaled	R	Number of starts trip counter.
00343	NumberOfStartsTripCounterLO			
00344	AutoRestartsTripCountHI	unscaled	R	Number of automatic restarts trip counter.
00345	AutoRestartsTripCountLO			
00346	InsulationResistance	10 k Ω	R	Motor insulation resistance.
00347	PhaseVoltageDistortion	0.01 %	R	Phase voltage distortion.
00348	VoltageMaxLog	0.1 V	R	Three-phase motor: Logged maximum voltage. Single-phase motor: Logged maximum phase voltage.
00349	VoltageMinLog	0.1 V	R	Three-phase motor: Logged minimum voltage. Single-phase motor: Logged minimum phase voltage.
00350	CurrentLineMaxLog	0.1 A	R	Logged maximum line current.
00351	CurrentLineMinLog	0.1 A	R	Logged minimum line current.
00352	StartsHourMaxLog	unscaled	R	Logged maximum number of starts per hour.
00353	StartsPerHour	unscaled	R	Number of starts per hour.

Register	Identifier	Scale	R/W	Description
00354	AutoRestartsPer24h	unscaled	R	Number of automatic restarts per 24 hours.
Alarm simulation register block				
00701	SimulationWarningBits1	bits	R/W	Used to generate simulated warnings or alarms. Simulated warnings or alarms can be reset with the ResetAlarm control bit (register 00101, bit 0) or by pressing the [R] button on the MP 204.
00702	SimulationWarningBits2	bits	R/W	
00703	SimulationAlarmBits1	bits	R/W	
00704	SimulationAlarmBits2	bits	R/W	Bit interpretation like WarningBits1 (register 00205) and WarningBits2 (register 00206).
User register block				
00751-00800	UserRegisters	unscaled	R/W	This area is for device labelling by the user (SCADA system). The CIU 250 will not modify this area by itself. The user register values are stored in the device and will remain after a power-off.

10. Grundfos alarm and warning codes

This is a general Grundfos alarm and warning code list. Not all codes are available in the MP 204.

Code	Description	Code	Description	Code	Description
1	Leakage current	35	Gas in pump head, deaerating problem	76	Internal communication fault
2	Missing phase	36	Discharge valve leakage	77	Communication fault, twin-head pump
3	External fault signal	37	Suction valve leakage	78	Fault, speed plug
4	Too many restarts	38	Vent valve defective	79	Functional fault, add-on module
5	Regenerative braking	40	Undervoltage	80	Hardware fault, type 2
6	Mains fault	41	Undervoltage transient	81	Verification error, data area (RAM)
7	Too many hardware shutdowns	42	Cut-in fault (dV/dt)	82	Verification error, code area (ROM, FLASH)
8	PWM switching frequency reduced	45	Voltage asymmetry	83	Verification error, FE parameter area (EEPROM)
9	Phase sequence reversal	48	Overload	84	Memory access error
10	Communication fault, pump	49	Overcurrent (i_line, i_dc, i_mo)	85	Verification error, BE parameter area (EEPROM)
11	Water-in-oil fault (motor oil)	50	Motor protection function, general shutdown (mpf)	88	Sensor fault
12	Time for service (general service information)	51	Blocked motor/pump	89	Signal fault, (feedback) sensor 1
13	Moisture alarm, analog	52	Motor slip high	90	Signal fault, speed sensor
14	Electronic DC-link protection activated (ERP)	53	Kipped motor	91	Signal fault, temperature 1 sensor
15	Communication fault, main system (SCADA)	54	Motor protection function, 3 sec. limit	92	Calibration fault, (feedback) sensor
16	Other	55	Motor current protection activated (MCP)	93	Signal fault, sensor 2
17	Performance requirement cannot be met	56	Underload	94	Limit exceeded, sensor 1
18	Commanded alarm standby (trip)	57	Dry running	95	Limit exceeded, sensor 2
19	Diaphragm break (dosing pump)	58	Low flow	96	Setpoint signal outside range
20	Insulation resistance low	59	No flow	97	Signal fault, setpoint input
21	Too many starts per hour	64	Overtemperature	98	Signal fault, input for setpoint influence
22	Moisture switch alarm, digital	65	Motor temperature 1 (t_m or t_mo or t_mo1)	99	Signal fault, input for analog setpoint
23	Smart trim gap alarm	66	Temperature, control electronics (t_e)	104	Software shutdown
24	Vibration	67	Temperature too high, internal frequency converter module (t_m)	105	Electronic rectifier protection activated (ERP)
25	Setup conflict	68	External temperature/ water temperature (t_w)	106	Electronic inverter protection activated (EIP)
26	Load continues even if the motor has been switched off	69	Thermal relay 1 in motor (e.g. Klixon)	110	Skew load, electrical asymmetry
27	External motor protector activated (e.g. MP 204)	70	Thermal relay 2 in motor (e.g. thermistor)	111	Current asymmetry
28	Battery low	71	Motor temperature 2 (Pt100, t_mo2)	112	Cos ϕ too high
29	Turbine operation (impellers forced backwards)	72	Hardware fault, type 1	113	Cos ϕ too low
30	Change bearings (specific service information)	73	Hardware shutdown (HSD)	120	Auxiliary winding fault (single-phase motors)
31	Change varistor(s) (specific service information)	74	Internal supply voltage too high	121	Auxiliary winding current too high (single-phase motors)
32	Overvoltage	75	Internal supply voltage too low	122	Auxiliary winding current too low (single-phase motors)

Code	Description	Code	Description	Code	Description
123	Start capacitor, low (single-phase motors)	183	Signal fault, extra temperature sensor	215	Soft pressure build-up timeout
124	Run capacitor, low (single-phase motors)	184	Signal fault, general-purpose sensor	216	Pilot pump alarm
144	Motor temperature 3 (Pt100, t_mo3)	185	Unknown sensor type	217	Alarm, general-purpose sensor high
145	Bearing temperature high (Pt100), in general or top bearing	186	Signal fault, power meter sensor	218	Alarm, general-purpose sensor low
146	Bearing temperature high (Pt100), middle bearing	187	Signal fault, energy meter	219	Pressure relief not adequate
147	Bearing temperature high (Pt100), bottom bearing	188	Signal fault, user-defined sensor	220	Fault, motor contactor feedback
148	Motor bearing temperature high (Pt100) in drive end (DE)	189	Signal fault, level sensor	221	Fault, mixer contactor feedback
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	190	Sensor limit 1 exceeded (e.g. alarm level in WW application)	222	Time for service, mixer
152	Communication fault, add-on module	191	Sensor limit 2 exceeded (e.g. high level in WW application)	223	Maximum number of mixer starts per hour exceeded
153	Fault, analog output	192	Sensor limit 3 exceeded (e.g. overflow level in WW application)	224	Pump fault (due to auxiliary component or general fault)
154	Communication fault, display	193	Sensor limit 4 exceeded	225	Communication fault, pump module
155	Inrush fault	194	Sensor limit 5 exceeded	226	Communication fault, I/O module
156	Communication fault, internal frequency converter module	195	Sensor limit 6 exceeded	227	Combi event
157	Real-time clock out of order	196	Operation with reduced efficiency	228	Not used
158	Hardware circuit measurement fault	197	Operation with reduced pressure	229	Not used
159	CIM fault (Communication Interface Module)	198	Operation with increased power consumption	230	Network alarm
160	GSM modem, SIM card fault	199	Process out of range (monitoring/estimation/calculation/control)	231	Ethernet: No IP address from DHCP server
168	Signal fault, pressure sensor	200	Application alarm	232	Ethernet: Auto-disabled due to misuse
169	Signal fault, flow sensor	201	External sensor input high	233	Ethernet: IP address conflict
170	Signal fault, water-in-oil (WIO) sensor	202	External sensor input low	236	Pump 1 fault
171	Signal fault, moisture sensor	203	Alarm on all pumps	237	Pump 2 fault
172	Signal fault, atmospheric pressure sensor	204	Inconsistency between sensors	238	Pump 3 fault
173	Signal fault, rotor position sensor (Hall sensor)	205	Level float switch sequence inconsistency	239	Pump 4 fault
174	Signal fault, rotor origo sensor	206	Water shortage, level 1	240	Lubricate bearings (specific service information)
175	Signal fault, temperature 2 sensor (t_mo2)	207	Water leakage	241	Motor phase failure
176	Signal fault, temperature 3 sensor (t_mo3)	208	Cavitation	242	Automatic motor model recognition failed
177	Signal fault, Smart trim gap sensor	209	Non-return valve fault	243	Motor relay has been forced (manually operated/commanded)
178	Signal fault, vibration sensor	210	Overpressure	244	Fault, On/Off/Auto switch
179	Signal fault, bearing temperature sensor (Pt100), general or top bearing	211	Underpressure	245	Pump continuous runtime too long
180	Signal fault, bearing temperature sensor (Pt100), middle bearing	212	Diaphragm tank precharge pressure out of range	246	User-defined relay has been forced (manually operated/commanded)
181	Signal fault, PTC sensor (short-circuited)	213	VFD not ready	247	Power-on notice (device/system has been switched off)
182	Signal fault, bearing temperature sensor (Pt100), bottom bearing	214	Water shortage, level 2	248	Fault, battery/UPS

11. Modbus telegrams and function codes

11.1 Modbus telegram overview

The maximum size of a Modbus RTU telegram is 256 bytes. Telegrams must be separated by a silent interval of at least 3.5 character times.

The standard Modbus RTU telegram format is shown in the table below:

Slave address	Function code	Data	CRC
1 byte	1 byte	0 to 252 bytes	2 bytes

A telegram starts with the slave address occupying one byte. The function code comes next. See section [4. Modbus function code overview](#) for supported function codes. Then comes a variable-size data field. For each telegram, a CRC is calculated and appended to the telegram (two bytes total). All bytes in the telegram, except for the CRC itself, are included in the check.

Note

The CRC bytes are not shown in the examples in the following sections.

11.2 Read holding registers (0x03)

This function is used for reading holding registers from the slave.

The request telegram specifies the starting address (the address of the first register to be read) and the number of holding registers to read. In the telegram, register addresses start from zero, meaning that registers numbered 1-16 are addressed as 0-15.

The register data in the response message are packed two bytes per register. For each register, the first byte contains the high-order bits while the second byte contains the low-order bits.

Example of request from master to slave

Address	Function code	Start address HI	Start address LO	Quantity HI	Quantity LO
0x01	0x03	0x00	0x6B	0x00	0x03

In the request, the slave with address 1 is asked to deliver three contiguous registers starting from address 0x006b = 107 (meaning register 108).

Example of response from slave to master

Address	Function code	Byte count	Register 108 HI	Register 108 LO	Register 109 HI	Register 109 LO	Register 110 HI	Register 110 LO
0x01	0x03	0x06	0x00	0x01	0x00	0x01	0x00	0x01

In the response, the byte count is six since there are three registers of two bytes. All three registers hold the value of 0x0001.

11.3 Read input registers (0x04)

This function is used for reading input registers from the slave. Input registers are read-only registers by definition. The request telegram specifies the starting address (the address of the first register to be read) and the number of holding registers to read. In the telegram, register addresses start from zero, meaning that registers numbered 1-16 are addressed as 0-15.

The register data in the response message are packed two bytes per register. For each register, the first byte contains the high-order bits while the second byte contains the low-order bits.

Example of request from master to slave

Address	Function code	Start address HI	Start address LO	Quantity HI	Quantity LO
0x01	0x04	0x10	0x10	0x00	0x03

In the request, the slave with address 1 is asked to deliver three contiguous registers starting from address 0x1010 = 4112 (meaning register 4113).

Example of response from slave to master

Address	Function code	Byte count	Register 4113 HI	Register 4113 LO	Register 4114 HI	Register 4114 LO	Register 4115 HI	Register 4115 LO
0x01	0x04	0x06	0x22	0x22	0x22	0x22	0x22	0x22

In the response, the byte count is six since there are three registers of two bytes. All three registers hold the value of 0x2222.

11.4 Write single register (0x06)

This function is used for writing a single holding register in the slave. The request telegram specifies the address of the register that is to be written. Register addresses start from zero, meaning that a register numbered 10 is addressed as 9.

The normal response is an echo of the request, indicating that the value was written.

Example of request from master to slave

Address	Function code	Address HI	Address LO	Value HI	Value LO
0x01	0x06	0x10	0x00	0xAF	0xFE

In the request, the slave with address 1 is asked to write the value of 0xAFFE to the register at address 0x1000.

Example of response from slave to master

Address	Function code	Address HI	Address LO	Value HI	Value LO
0x01	0x06	0x10	0x00	0xAF	0xFE

The response is an echo of the request.

11.5 Write multiple registers (0x10)

This function is used for writing a block of contiguous holding registers in the slave. Register addresses start from zero, meaning that a register numbered 100 is addressed as 99.

Example of request from master to slave

Address	Function code	Start address HI	Start address LO	Quantity HI	Quantity LO	Byte count	Register 33 HI	Register 33 LO	Register 34 HI	Register 34 LO
0x01	0x10	0x00	0x20	0x00	0x02	0x04	0x00	0x01	0xB0	0xB0

In the request, the slave with address 1 is asked to write the value of 0x0001 to the register at address 0x0020 and the value of 0xB0B0 to the register at address 0x0021.

Example of response from slave to master

Address	Function code	Start address HI	Start address LO	Quantity written HI	Quantity written LO
0x01	0x10	0x00	0x20	0x00	0x02

The response returns the function code, starting address and quantity of registers written.

11.6 Diagnostics (0x08)

This function provides a test for checking the communication system between the master and the Grundfos slave. It contains a single-byte subcode to identify the test to be performed.

The following subcodes are supported:

Subcode	Name
0x00	Return query data Data in this request are to be echoed in the response. The response must be identical to the request, so this function is often used to verify Modbus communication.
0x01	Restart communications All communication counters are cleared, and the device is restarted.
0x02	Return diagnostics register Returns the 16-bit diagnostics register. See section 11.7 Diagnostics register interpretation .
0x04	Force Listen Only Forces the device into listen-only mode. This effectively mutes the device, making it unable to communicate on the network. To bring the device back to normal mode, a "Restart communications" command (code 0x08, subcode 0x01) must be issued.
0x0A	Clear counters and diagnostics register Clears all counters and the diagnostics register. (These are also cleared on power-up/restart).
0x0B	Return bus message count Returns the number of messages detected by the slave.
0x0C	Return bus CRC error count Returns the number of CRC errors in the slave.
0x0D	Return bus exception count Returns the number of Modbus exception responses that the slave has transmitted.
0x0E	Return slave message count Returns the number of messages that the slave has processed.
0x0F	Return slave no response count Returns the number of messages for which the slave has sent no response.
0x12	Return bus character overrun count Returns the number of overruns in the slave.
0x14	Clear overrun counter Clears the overrun counter. (This is also cleared on power-up/restart).

Example of response from master to slave

Address	Function code	Subcode	Data	Data
0x01	0x08	0x00	0xAB	0xCD

The response is identical to the request.

Example of response from slave to master

Address	Function code	Subcode	Data	Data
0x01	0x08	0x00	0xAB	0xCD

11.7 Diagnostics register interpretation

The diagnostics register is interpreted as follows:

Bit	Description
0	Internal communication failure (with the Grundfos CIU 250).
1	EEPROM self-test failed (the test is carried out when the system is booted).
2	Grundfos CIU 250 not supported.
3	Modbus address offset is different from default value, i.e. it differs from 0.
4	Using software-defined Modbus transmission speed.
5	RESERVED
6	RESERVED
7	RESERVED
8	RESERVED
9	RESERVED
10	RESERVED
11	RESERVED
12	RESERVED
13	RESERVED
14	RESERVED
15	RESERVED

A bit value of 1 means true, unless otherwise specified. The diagnostics register is read using function code 0x08 and subcode 0x02.

12. Modbus telegram examples

Note

CRC fields are not shown in the following examples.

Note

The Modbus data model states that registers numbered X are addressed in telegrams as X - 1, e.g. register 00104 (setpoint) is addressed as 00103 in a Modbus telegram.

12.1 Diagnostics: return query data

This function is useful to ensure that the communication path and slave configuration are correct. It will echo the request in the response.

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x08	Diagnostics
Subcode	0x00	Echo request
Data	0xAB	Test data
Data	0xCD	Test data

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x08	Diagnostics
Subcode	0x00	Echo request
Data	0xAB	Test data
Data	0xCD	Test data

If there is no response from the slave, see section [9. Data item overview](#).

12.2 Reading the CIM configuration register block

This section shows how to read the first four registers of the CIM configuration register block.

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Start address HI	0x00	Start address = 0x0001
Start address LO	0x00	
Quantity HI	0x00	Number of registers = 0x0004
Quantity LO	0x04	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Byte count	0x08	8 bytes follow
00001 HI	0x00	SlaveMinimumReplyDelay = 0x000A
00001 LO	0x0A	
00002 HI	0x00	RegisterOffset = 0x0000
00002 LO	0x00	
00003 HI	0x00	Reserved value = 0x0000
00003 LO	0x00	
00004 HI	0x00	ModbusBitRate = 0x0004
00004 LO	0x04	

If there is no response from the slave, see section [9. Data item overview](#).

12.3 Tripping the MP 204

This section shows how to set the control bit that trips the MP 204.

In the example, slave address 0x01 is used.

To trip the MP 204, the ControlRegister (register address 00101, bit 1) must be raised.

Hence the value to set is 0b0000000000000010 = 0x0002.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 2 (0x0002)
Value LO	0x02	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 2 (0x0002)
Value LO	0x02	

If there is no response from the slave, see section [9. Data item overview](#).

12.4 Resetting an alarm

This section shows how to set the control bit that resets MP 204 alarms.

In the example, slave address 0x01 is used.

To reset an alarm, the ControlRegister (register address 00101, bit 0) must be raised.

Hence the value to set is 0b0000000000000001 = 0x0001.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 1 (0x0001)
Value LO	0x01	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 1 (0x0001)
Value LO	0x01	

If there is no response from the slave, see section [9. Data item overview](#).

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